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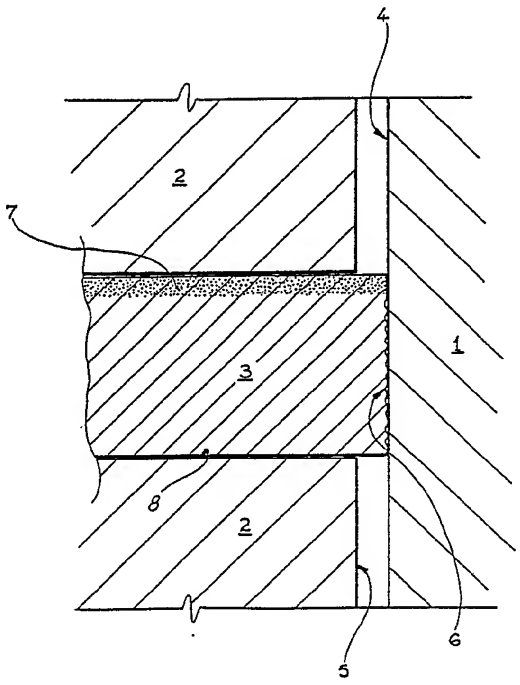
(54) Title: PISTON RINGS

(57) Abstract

An improved design of compression piston ring (3) for use in internal combustion reciprocating engines, the piston ring (3) having a peripheral cylinder engaging surface (6) with an edge zone (7) adapted to face towards a combustion zone of the engine cylinder (4), the edge zone (7) forming a layer having a hardness or wear resistance greater than the remainder of the peripheral surface, the said remainder of the peripheral surface, at least during initial use, being textured to provide a multiplicity of small contact areas which may wear more quickly than said edge zone (7), alignment of the piston ring (3) may be ensured by having the piston ring groove (8) made of a material of greater wear resistance than the remainder of the piston (2).



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PISTON RINGS

The invention concerns improvements in compression piston rings for piston internal combustion engines.

In piston internal combustion engines, compression piston rings are provided to prevent leakage of combustion-generated pressure from the combustion chamber past the piston into the crankcase. Cylinder leakage results in a decrement in engine performance and efficiency due to the loss of gas pressure.

Additionally and more importantly, it reduces engine life as a result of overheating due to transfer of heat to the cylinder walls, contamination of lubricant resulting in increased wear rates, and damage to pistons resulting from overheating and accumulation of deposits of burned oil.

In conventional compression piston ring designs, attention is usually given to the maximisation of pressure against the cylinder bore of the lower edge of the ring, that is to say, the edge of the ring nearest the crankcase. This is to ensure the existence of a scraping effect which minimises the quantity of lubricating oil which finds its way to the combustion chamber. Increased cylinder bore pressure of the lower edge of the piston ring is generally achieved by tapering the cylinder bore contact face or by chamfering or counter-boring the inner upper edge of the ring to obtain a relaxation of pressure at the upper part of its contact face.

In the modern engine, in which oil contol piston rings are efficient, the requirement for the compression piston ring to exert a cylinder bore scraping effect is redundant. At the same time, it can be demonstrated that cylinder leakage is common in the modern mass-produced piston engine. It can also be demonstrated that positive sealing of the compression piston ring depends upon the maintenance of a sharp upper edge of the ring, and that sealing is effected by a very narrow band at the upper edge of the piston ring cylinder bore contact face.

As the compression piston ring wears, cylinder bore contact pressure is diminished, its upper edge becomes worn and slightly rounded and cylinder leakage commences. This process is accelerated in the abovementioned design of piston ring, because of the tendency to reduce the cylinder bore contact pressure of the upper edge of the ring.

The present invention aims at providing an engine compression piston ring which substantially extends the life of an engine by minimising the development of cylinder leakage caused by wear.

According to the present invention there is provided a compression piston ring for an engine defining a peripheral face adapted to engage an engine cylinder wall, said ring being characterized by a peripheral edge adapted to face toward a pressure zone of said cylinder being more resistant to wear than the remainder of the peripheral face of the said ring. Preferably the said wear resistant peripheral edge is formed by a thin zone of either a different material to the remainder of the ring or by the same material as the remainder of the ring treated in an appropriate manner to provide said relatively wear resistant characteristic.

According to a second aspect of the present invention there is provided an engine compression piston ring for use in an engine cylinder defining a peripheral face divided into a first zone adjacent, in use, a pressure side of said cylinder and a second zone adjacent a crankcase side of said cylinder, said second zone, at least during initial stages of use being adapted to wear at a faster rate than said first zone. Conveniently said second zone is initially textured to provide a multiplicity of small contact areas which may wear more quickly. In a particularly preferred arrangement the first zone is arranged to be harder or more wear resistant than the second zone.

Initial service of the engine will result in rapid wear of the said multiplicity of small contact areas, ensuring that maximum cylinder bore contact pressure is quickly developed at the hardened upper edge of the piston ring. The hardness of the piston ring upper surface ensures that a sharp upper edge of the piston ring is maintained and the differential wear rates resulting from the difference in hardness of the two zones of the piston ring ensures that subsequent wear in service maintains maximum cylinder bore contact pressure at the piston ring upper edge.

The present invention will be more readily understood by reference to the following description of a preferred embodiment given in relation to the accompanying drawing which represents a transverse sectional view of a piston ring and an immediate area of the piston and cylinder bore.

With reference to the drawing, compression piston ring 3 is accommodated within groove 8 in piston 2. The upper surface 7 of the said piston ring is made with a thin layer of material harder than the other parts of the ring, said layer being created by electroplating the surface with a harder material, by fusing to it a layer of harder material, or by treating it with ion implantation techniques or the like. Excepting for the hardened upper edge, the cylinder bore contact face 6 of piston ring 3 is made textured such that it comprises a large multiplicity of small contact areas. This may be achieved by a multiplicity of shallow grooves, by a knurled configuration or by any other suitable means.

In an embodiment not shown, the piston ring groove is made of a harder, wear resistant material cast into the piston, to ensure the alignment of the said piston ring. The material from which cylinder block 1 or cylinder bore 4 are manufactured are selected to be compatible with the two piston ring materials.

In operation, initial wear of the said large multiplicity of small contact areas in the relatively softer textured cylinder bore contact face of the said piston ring, ensures that maximum cylinder bore contact pressure is developed at the harder upper edge. This ensures good ring seal at the earliest possible point in the life of the engine. The hardness of the said piston ring upper edge ensures that it maintains its sharpness in service. The subsequent differential wear rates of the harder upper edge and the lower softer parts of the piston ring ensures that maximum cylinder bore contact pressure is maintained at the said upper edge. The provision of a harder piston ring groove cast into the piston limits any tendency of the piston ring to twist as a result of the difference in cylinder bore contact pressures between its upper and lower edges.

CLAIMS:

1. A compression piston ring for an internal combustion engine defining an outer peripheral face adapted to engage a cylinder wall of said engine, said ring being characterized by a peripheral edge adapted to face toward a pressure zone of said cylinder being more resistant to wear than the remainder of the peripheral face of said ring.

2. A compression piston ring according to claim 1 wherein a first zone adjacent said peripheral edge is more resistant to wear than the remainder of said peripheral face of said ring.

3. A compression piston ring according to claim 2 wherein said ring is annular in shape and includes axial directed faces at either end of said outer peripheral face, said first zone extending across one of said axial directed faces.

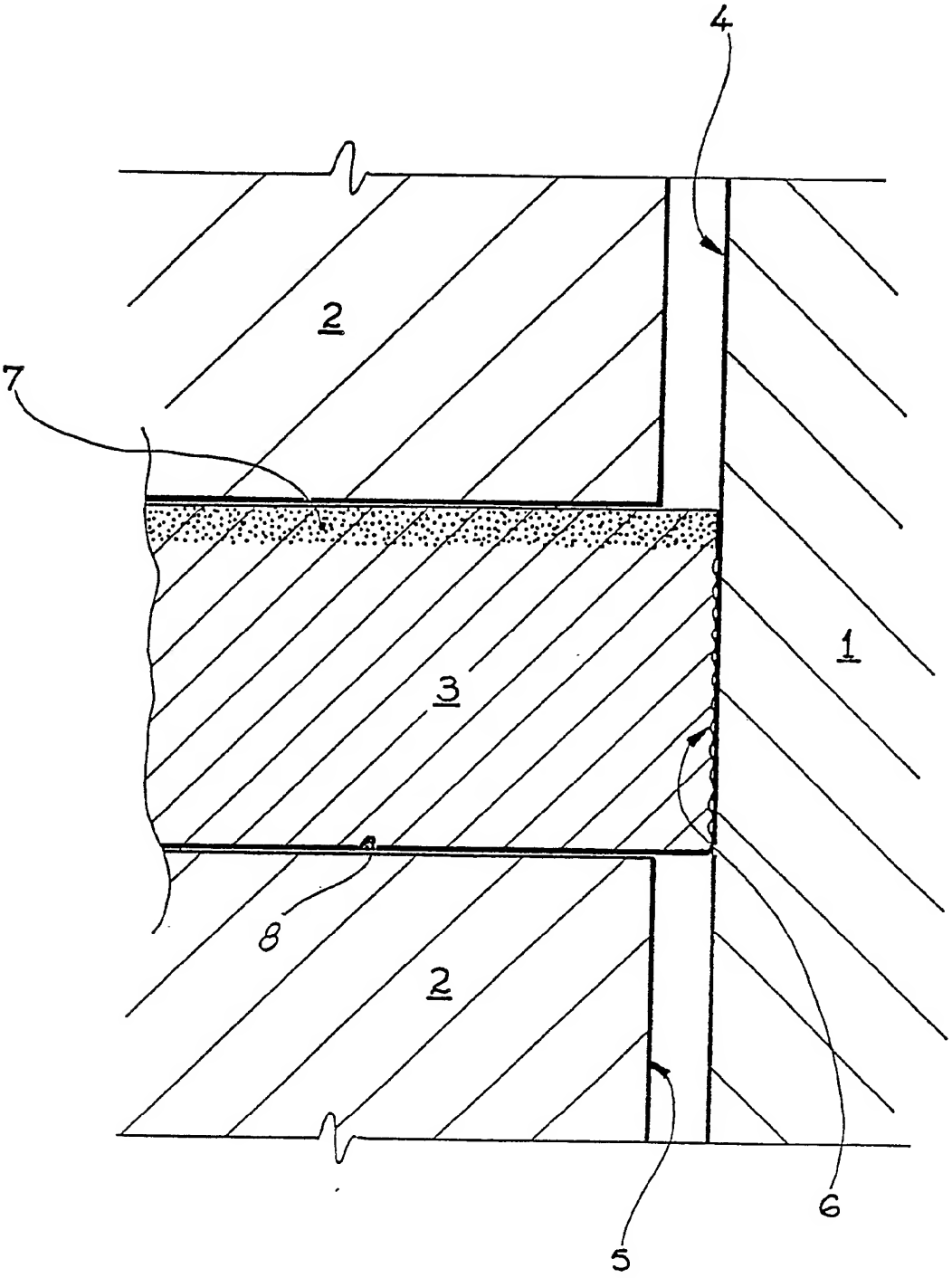
4. A compression piston ring according to claim 3 wherein said first zone is formed by a plated material coating applied to said one axial directed face.

5. A compression piston ring according to claim 2 or claim 3 wherein said first zone is formed by modifying the material and/or the structure of a base material from which the ring is produced.

6. A compression piston ring according to any one of claims 2 to 5 wherein the outer peripheral face of said ring comprises said first zone and at least one other zone, said other zone or each of said other zones, at least during initial use, being adapted to wear at a rate faster than that of said first zone.

7. A compression piston ring according to claim 6 wherein the or each said other zone comprises a surface texture including a multiplicity of small contact areas adapted to wear more quickly.

8. A piston for an internal combustion engine including a piston ring according to any one of claims 1 to 7 wherein the piston ring is arranged in a holding groove made of a material of greater wear resistance than the remainder of said piston.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INTERNATIONAL SEARCH REPORT

International Application No PCT/AU 87/00207

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[4] F02F 5/00, F16J 9/00

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC	F02F 5/00, F16J 9/00, 9/22, 9/26

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

AU: IPC as above; Australian Classification 60.7

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No [13]
X	US,A, 4414284 (EBIHARA) 8 November 1983 (08.11.83)	(1-3,6)
A	US,A, 2580124 (PHILLIPS) 25 December 1951 (25.12.51)	
X	US,A, 2488697 (ACKERMAN) 22 November 1949 (22.11.49)	(1-4,6)
A	US,A, 2148764 (MAACK) 28 February 1939 (28.02.39)	
A	GB,A, 1222072 (WELLWORTHY LIMITED) 10 February 1971 (10.02.71)	
X	GB,A, 664114 (THE BRITISH PISTON RING COMPANY LIMITED) 2 January 1952 (02.01.52)	(1-4,6)
A	EP,A1, 0035127 (CATERPILLAR TRACTOR CO.) 9 September 1981 (09.09.81)	

* Special categories of cited documents: [10]

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
25 September 1987 (25.09.87)	(09.10.87) 9 OCTOBER 1987
International Searching Authority	**Signature of Authorized Officer**
Australian Patent Office	O L Haggar (O.L. HAGGAR)

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON
INTERNATIONAL APPLICATION NO. PCT/AU 87/00207

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Members			
GB 1222072	CH 488951 US 3573874	DE 1750250	FR 1563340	
EP 35127	BR 8009036	CA 1141243	WO 8102586	
US 4414284	DE 3206980	JP 57144350		

END OF ANNEX